3D Representation of Clearance Scans

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WellArchitect[®] Integrate. Visualize. Analyze.

The ISCWSA

From the ISCWSA website (www.iscwsa.org):

- "The ... ISCWSA ... is seeking to dispel the confusion and secrecy currently associated with wellbore surveying...."
- "is seeking to dispel the confusion and secrecy currently associated with"...*numbers*....

Much of the work we do is centered around numbers and how to make those numbers usable and understandable to a wider audience.





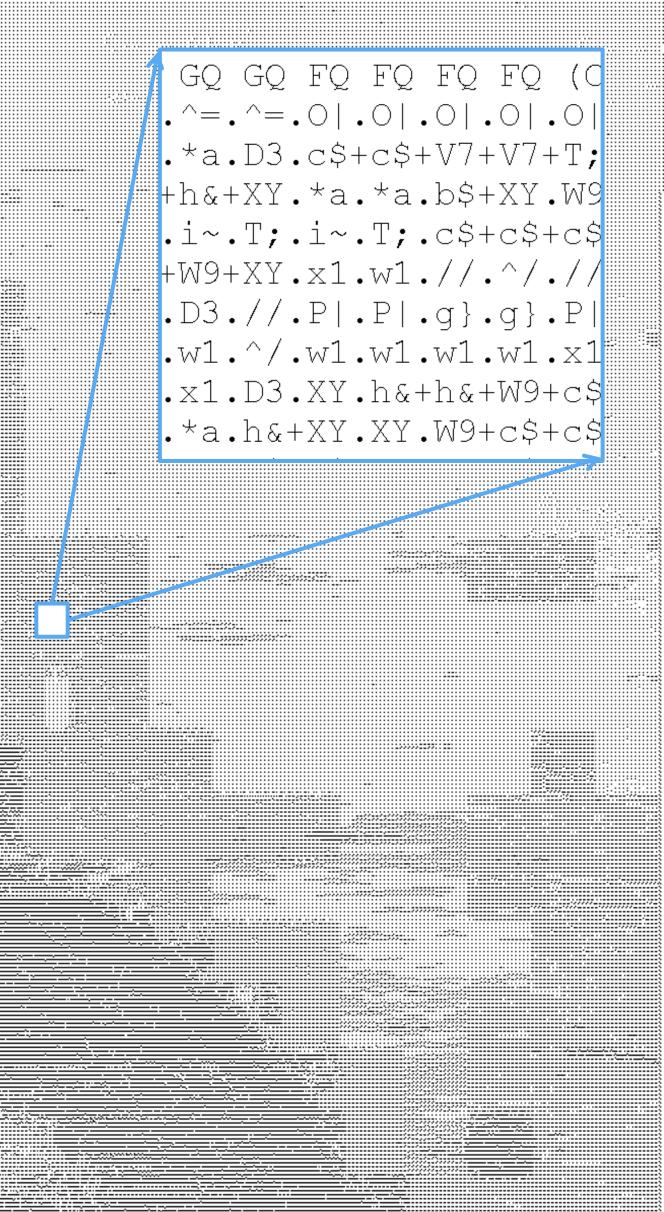
An Example: Do you know what it is?

	'ype: pr 'ersion:	-	rty scat	tered	data
# D	escript	ion	: Export	ed fr	om tif2pdat.py
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1	720	1	190	195	199
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3	720	1	187	192	196
4		1	186	191	195
5	720	1	185	190	194
б	720	1	185	190	194
7	720	1	186	191	195
8	720	1	187	192	196
9	720	1	186	191	195
10	720	1	187	192	196
11	720	1	188	193	197
12	720	1	188	193	197
13	720	1	189	194	198
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16	720	1	187	192	196
17	720	1	182	187	191

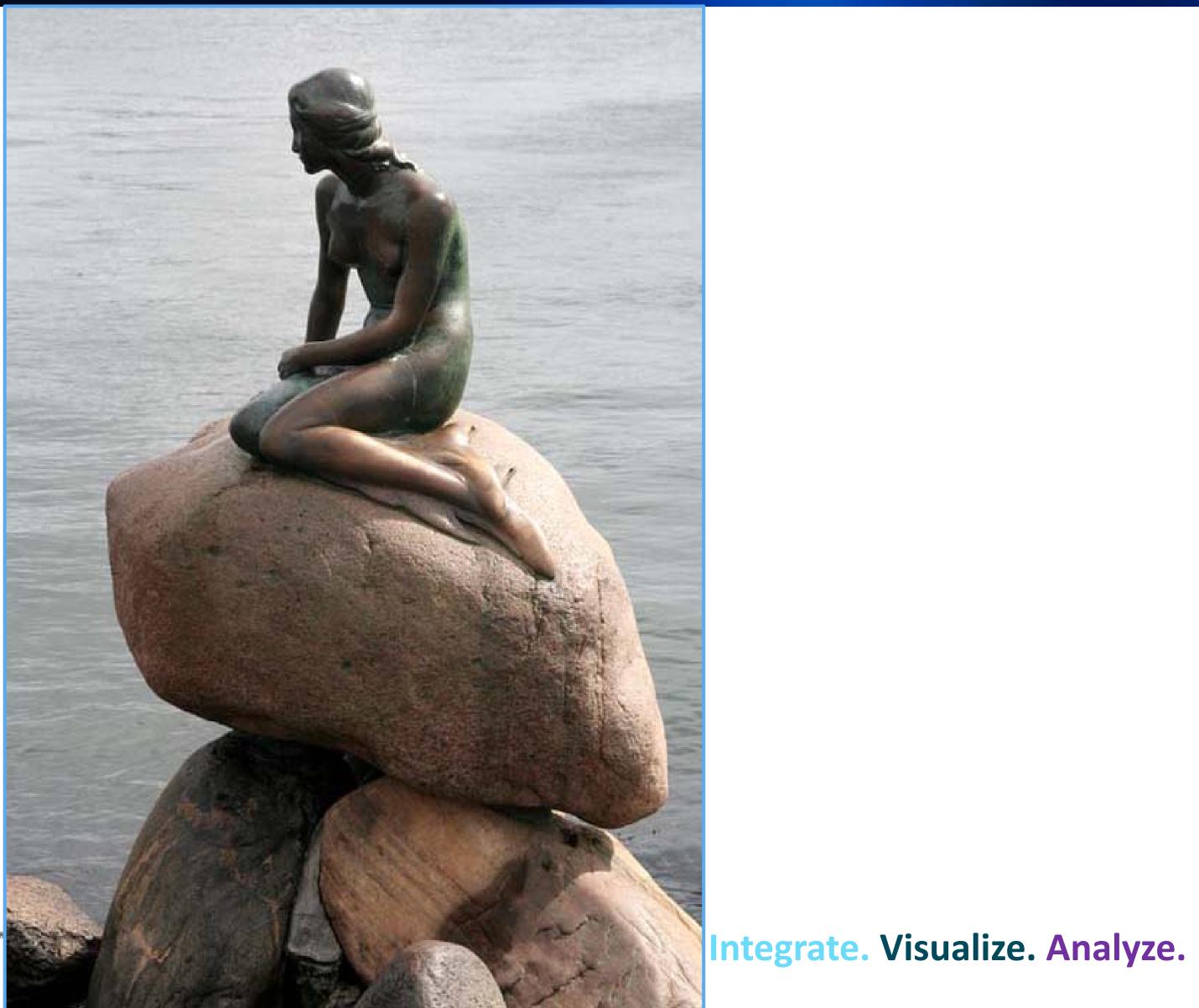


An Example: Do you know what it is?





An Example: Do you know what it is?



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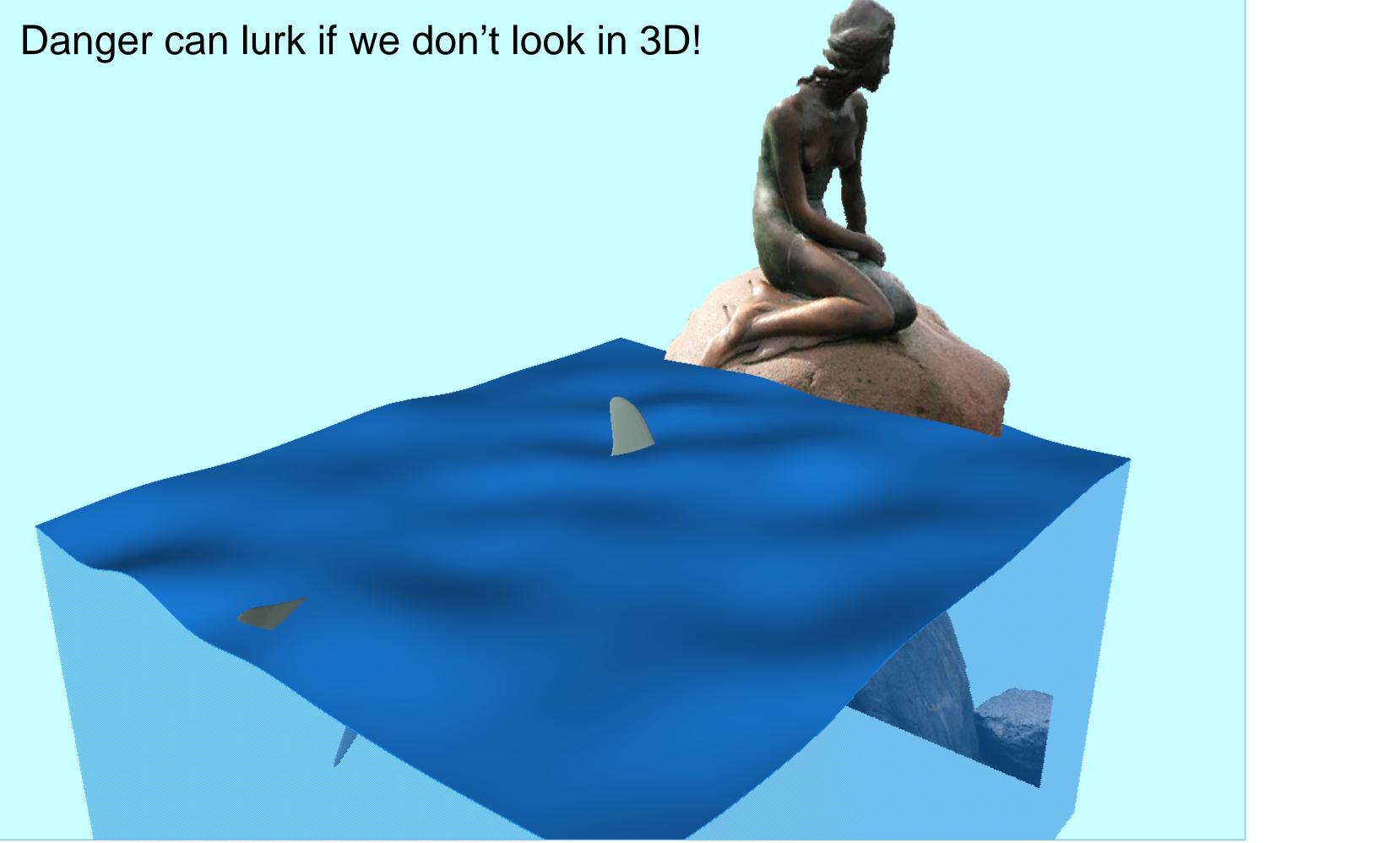
But What Happens When We Look at 3D Data in 3D?





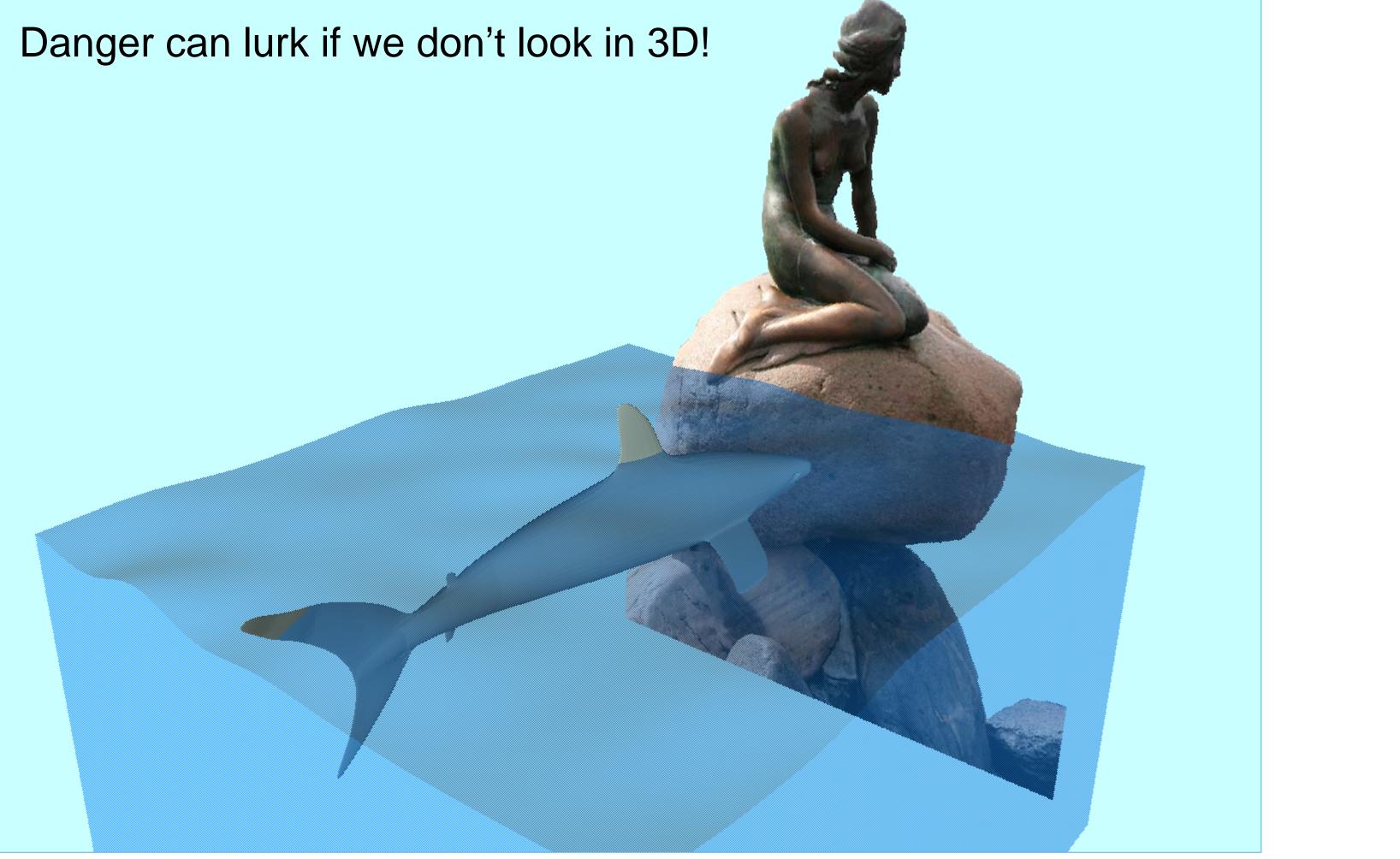
Visualize. Analyze.

But What Happens When We Look at 3D Data in 3D?



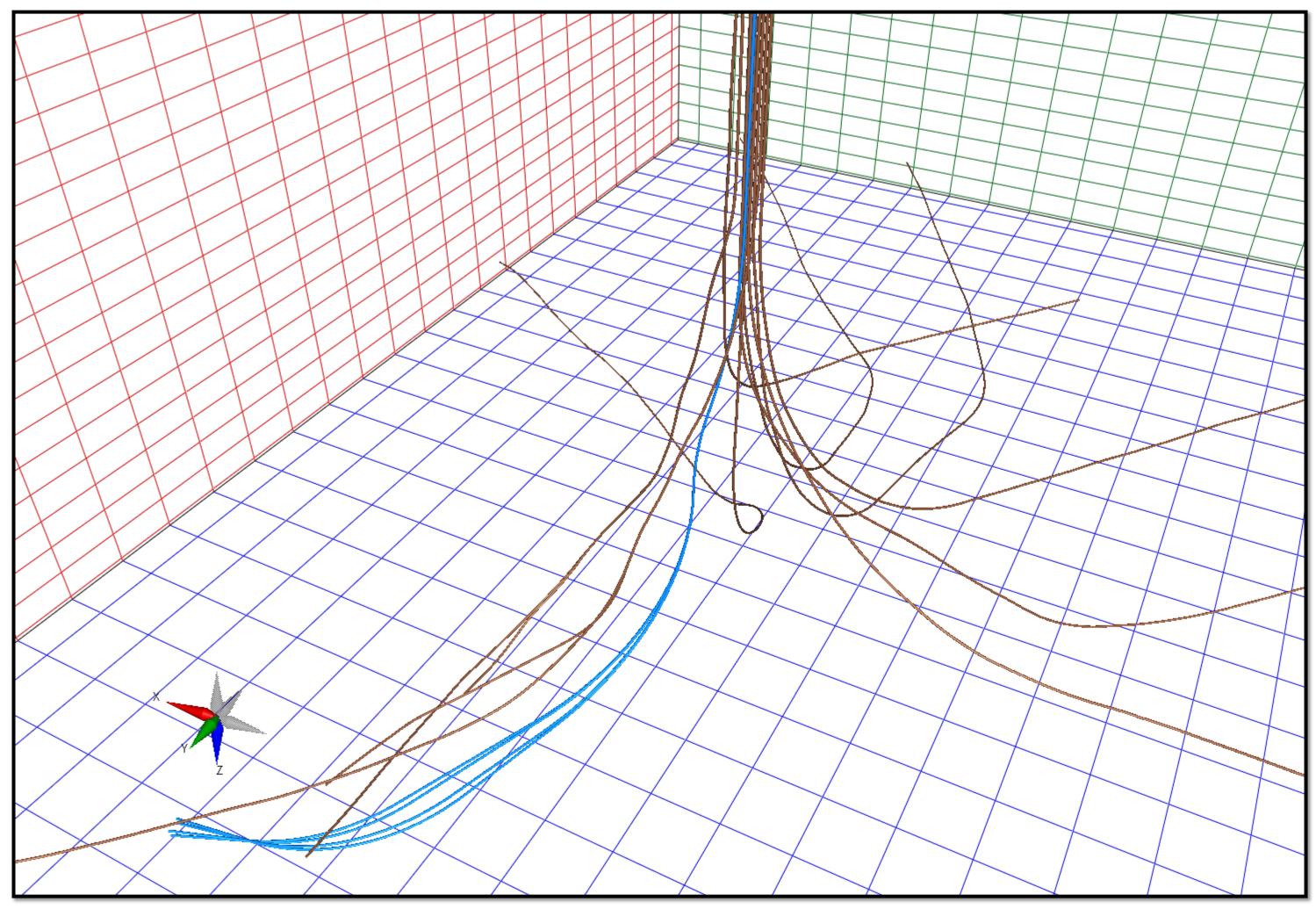


But What Happens When We Look at 3D Data in 3D?



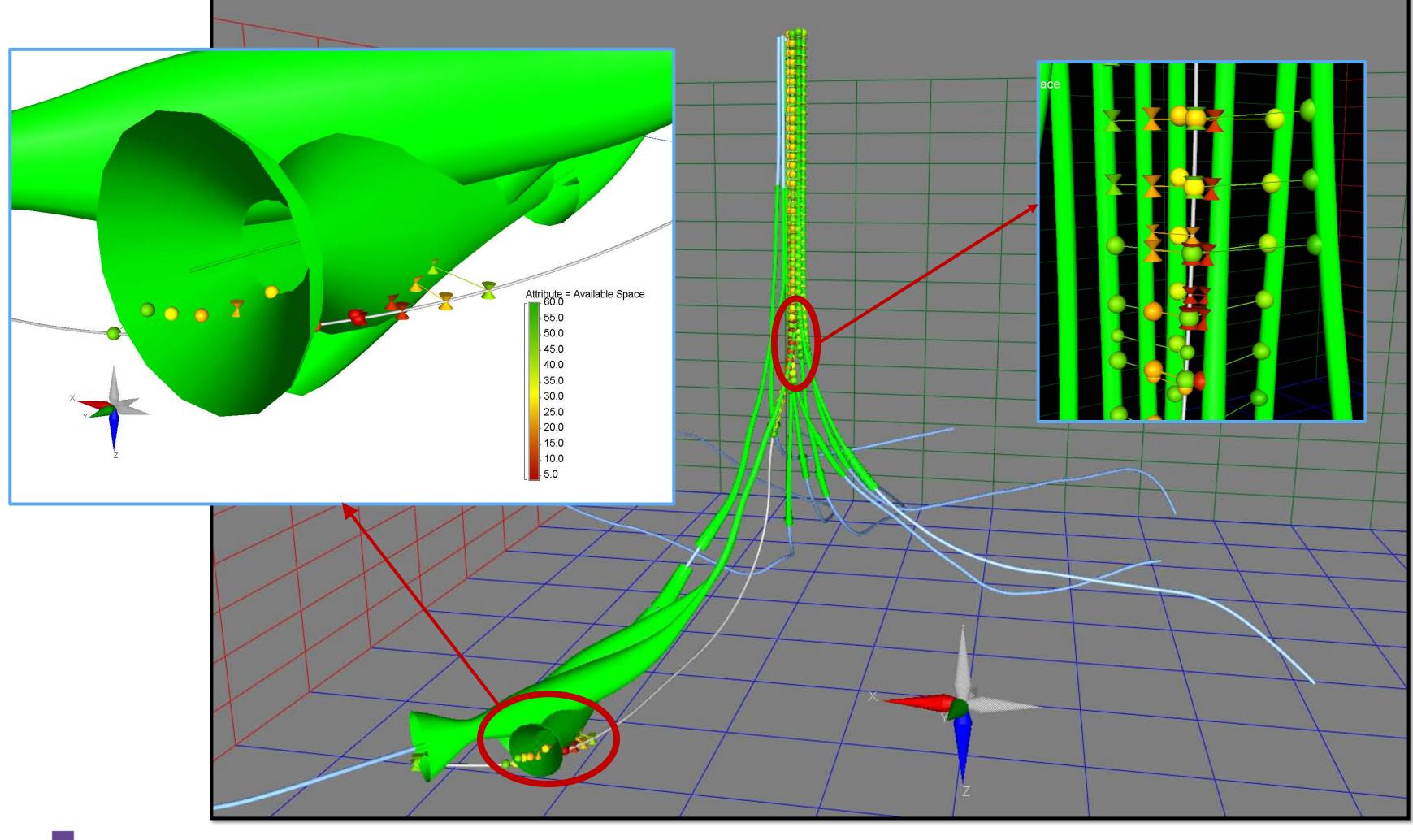


Breaking out through the tangle of wells





Breaking out through the tangle of wells







Traditional Clearance Report – 1D "The Numbers"



Clearance Report

Demo - initial 1000 Closest Approach Page 2 of 24

REFERENCE WELLPATH IDENTIFICATION

Operator	Aviemore	Slot	Demo
Area	Aviemore	Well	Demo well
Field	Aviemore	Wellbore	Demo wellbore
Facility	130/60A-D		

CALCULATION RANGE & CUTOFF

From: 0.00m MD

To: 1000.00m MD

C-C Cutoff: (none)

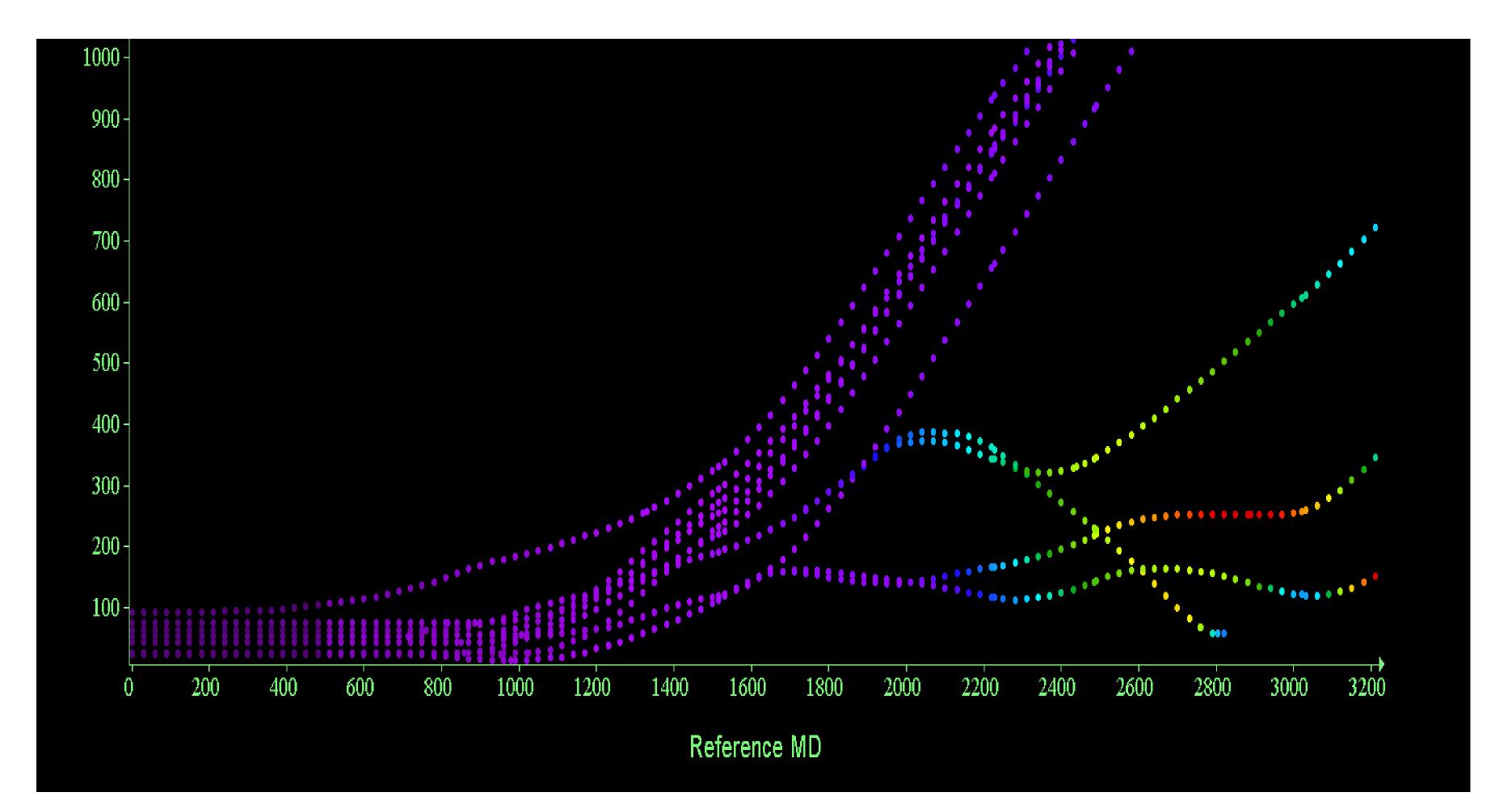
OFFSET WELL CLEARANCE SUMMARY (11 Offset Wellpaths selected)

						C-	C Clearance Di	istance	A	CR Separati	ion Distance			
	Offset acility	Offset Slot		fset Offset ell Wellbore	Offset Wellpatł		Min C-C Clear Dist [m]	Diverging from MD [m]	Ref MD of Min Sep Dist [m]	Min Sep Dist [m]	Min Sep Dist Dvrg From [m]	ACR Status		
130/6	i0A-D	D04	130/60A-D04(P11) 130/60A-D04	130/60A-D04	972.72	9.75	972.72	972.72	9.75	972.72	FAIL		
130/6	i0A-D	D04	130/60A-D04Z	(P11) 130/60A-D04Z	130/60A-D04Z	972.72	9.75	972.72	972.72	9.75	972.72	FAIL		
130/6	i0A-D	D02	130/60A-D02()	P13) 130/60A-D02	130/60A-D02	0.00	23.88	570.00	0.00	23.88	570.00	FAIL		
130/6	i0A-D	D08	130/60A-D08(P14) 130/60A-D08	130/60A-D08	600.00	25.17	600.00	600.00	25.17	600.00	FAIL		
130/6	i0A-D	D07	130/60A-D07											
130/6	i0A-D	D09	130/60A-D09		l C-	C Clearand	e Distanc	e		AC	R Separation	n Distan	ce	
130/6	i0A-D	D01	130/60A-D01								-			4.615
130/6	i0A-D	D06	130/60A-D06		Ref	Min C-C) Dix	rerging	Ref MD	of	Min	Min Se	ep Dist	ACR
130/6	i0A-D	D06	130/60A-D06	Offset	MD	Clear Dis	st fro	m MD	Min Sep I	Dist	Sep Dist	Dvrg	From	Status
	IOA-D	D03	130/60A-D03	Wellpath	[m]	[m]		[m]	[m]		[m]	[r	n] 👘	
130/6	i0A-D	D05	130/60A-D05	130/60A-D04	972.72		9.75	972.72		972.72	9.75		972.72	FAIL
				130/60A-D04Z	972.72	-	9.75	972.72	9	972.72	9.75		972.72	FAIL



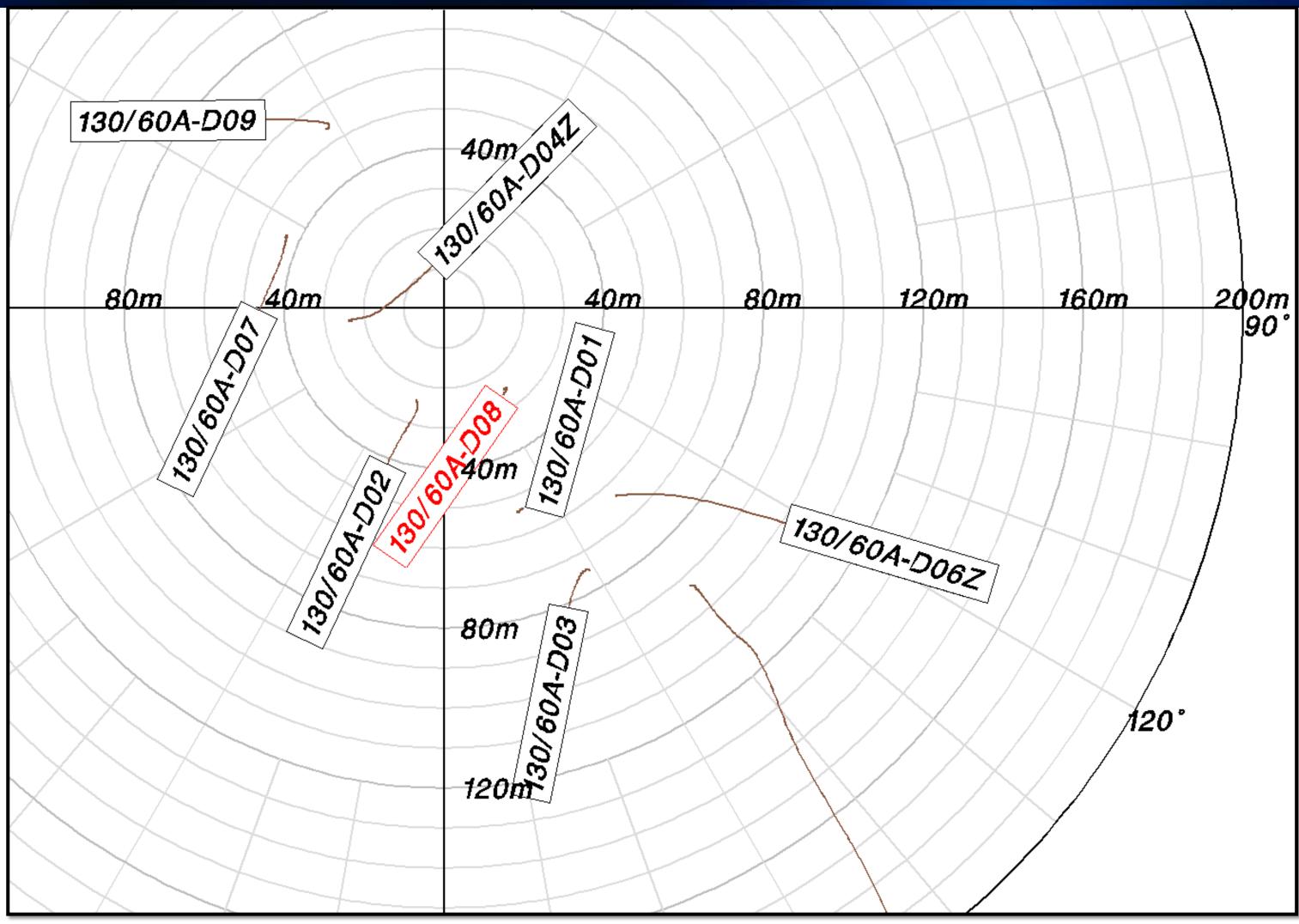
		DYNAMIC GRAPHICS	
)			
r			
A	CR Separatio	on Distance	
f ist	Min Sep Dist [m]	Min Sep Dist Dvrg From [m]	ACR Status
72.72	9.75	972.72	FAIL
72.72	9.75	972.72	FAIL
0.00	23.88	570.00	FAIL
00.00	25.17	600.00	FAIL

2D Representation of Report Numbers: Clearance Distance vs MD



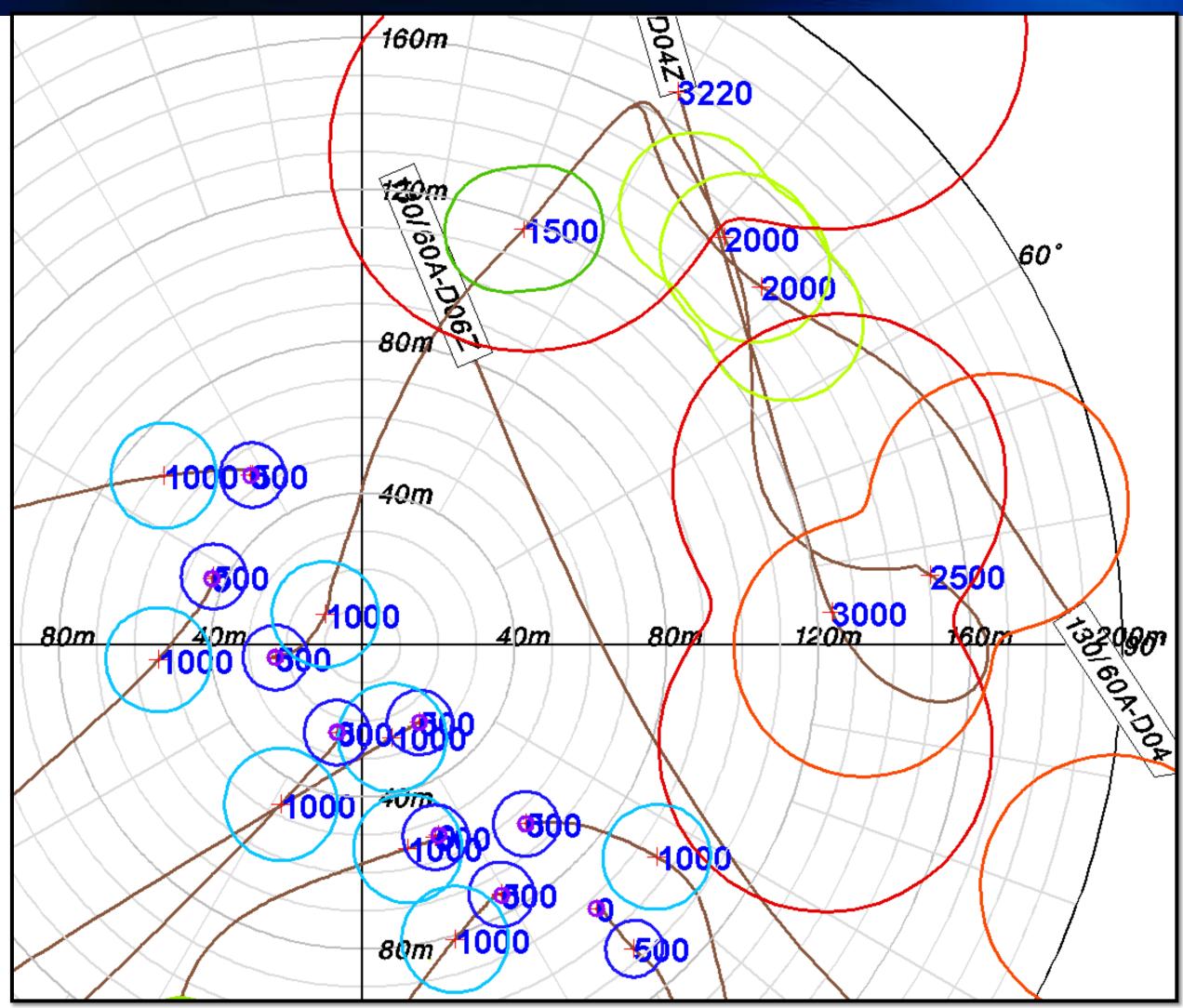


Clearance Data on Traveling Cylinder Plot – 2D



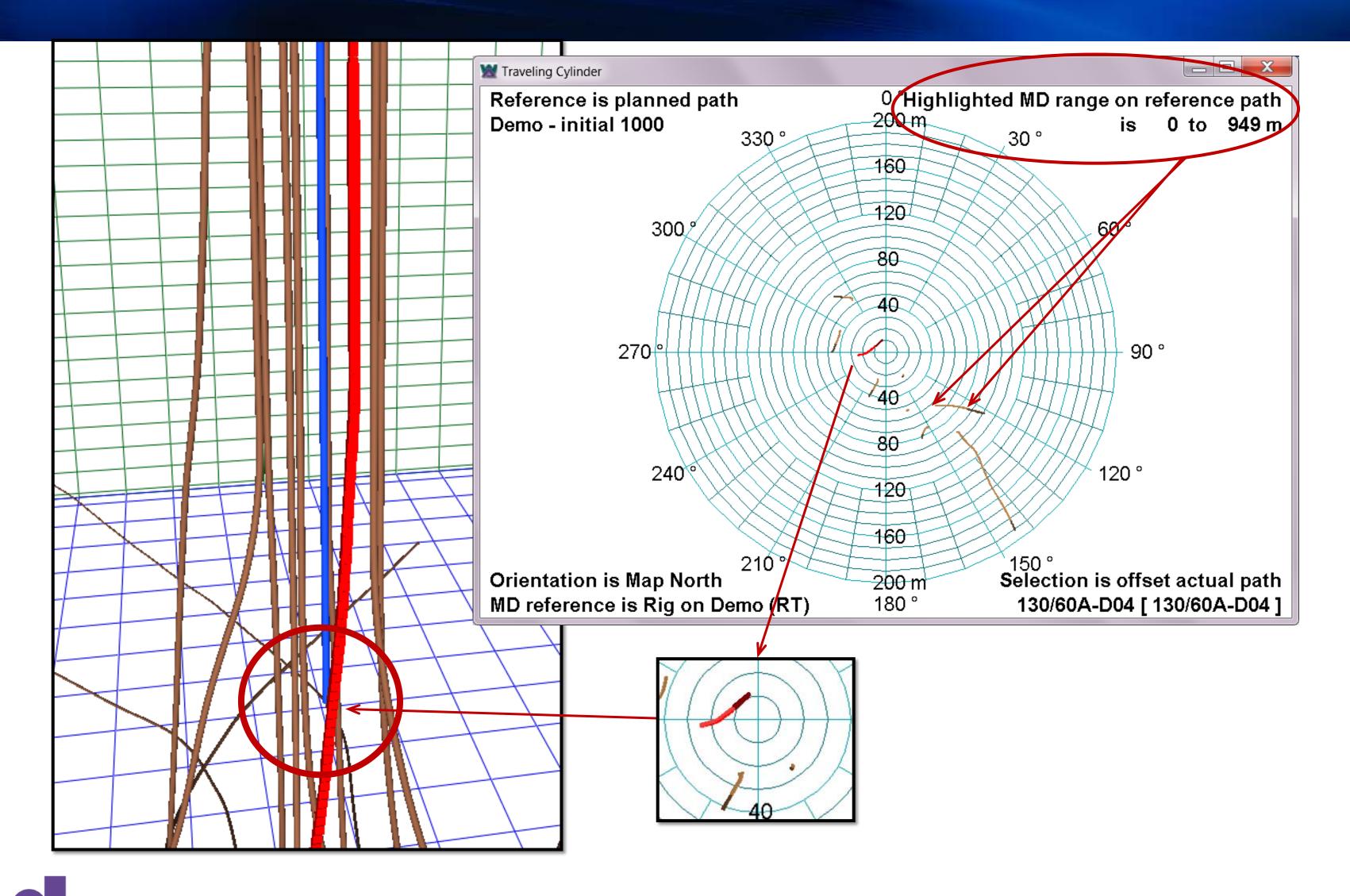


Clearance Data on Traveling Cylinder Plot – 2D



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Working with 2D representations with 3D

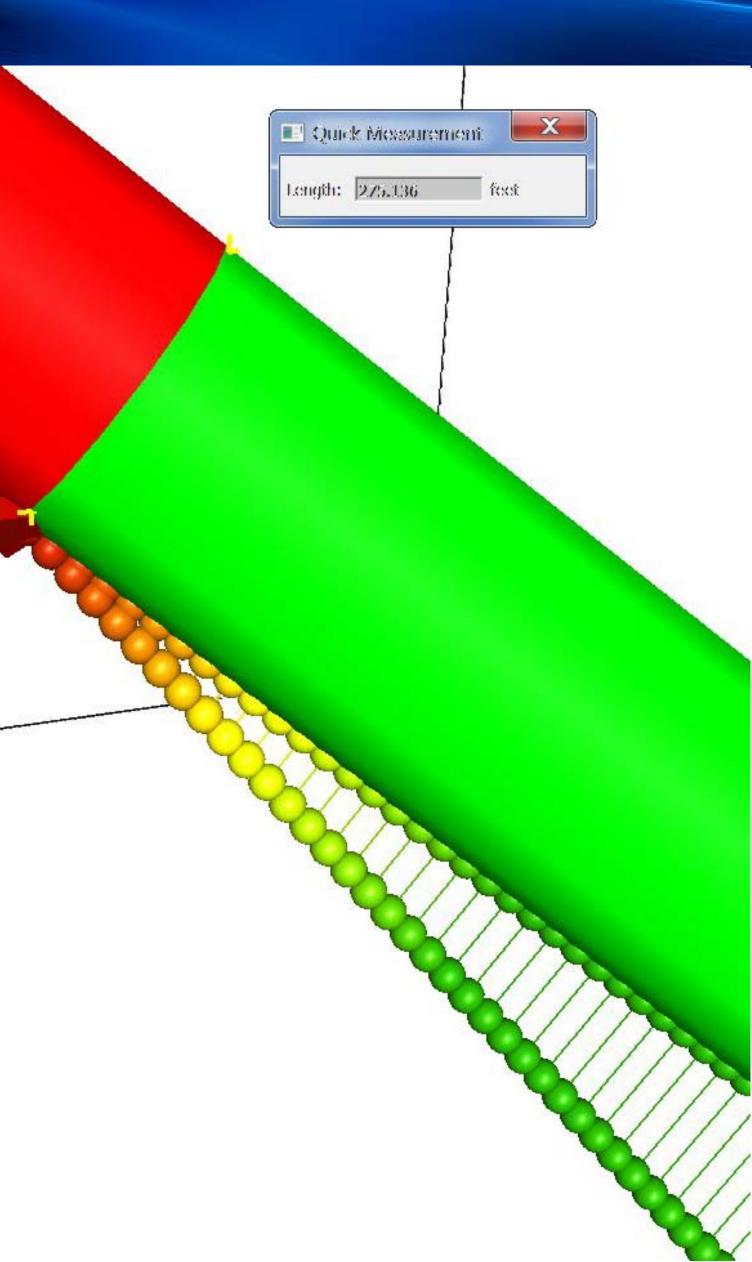


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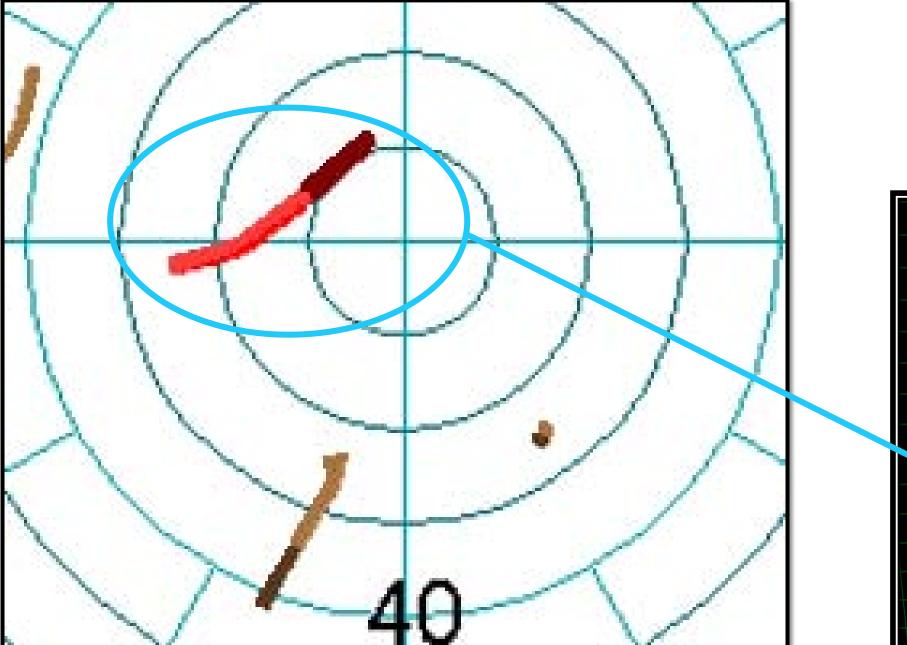
Represent the Clearance Data in 3D

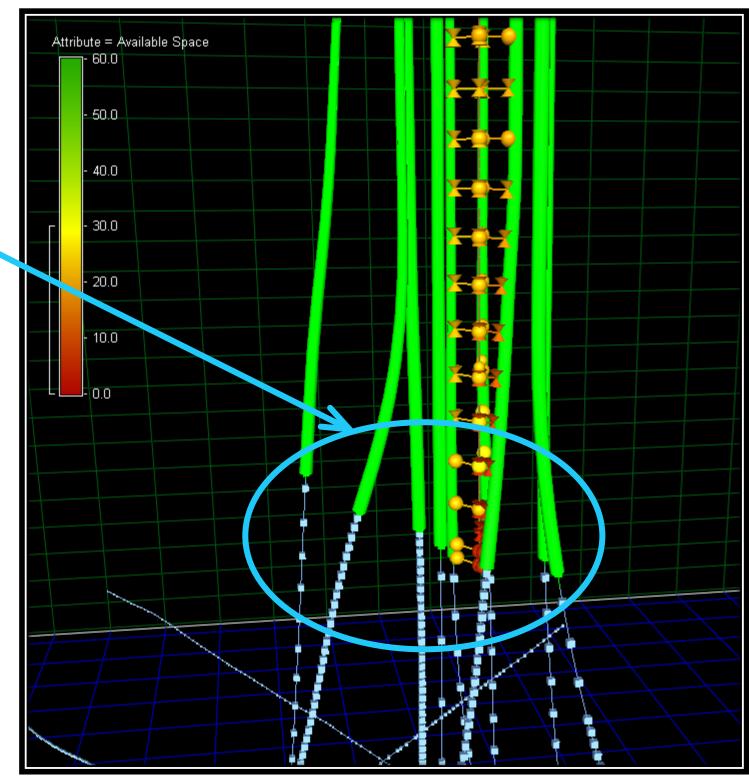
- Tube of "minimum" allowable separation distance" (MASD)
- ACR Pass / fail coloring on tube
- Add new information: "Available space" symbol based on ACR
- Does not replace reports, TC plots, etc – rather enhances the process

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Altering Path Based on Available Space

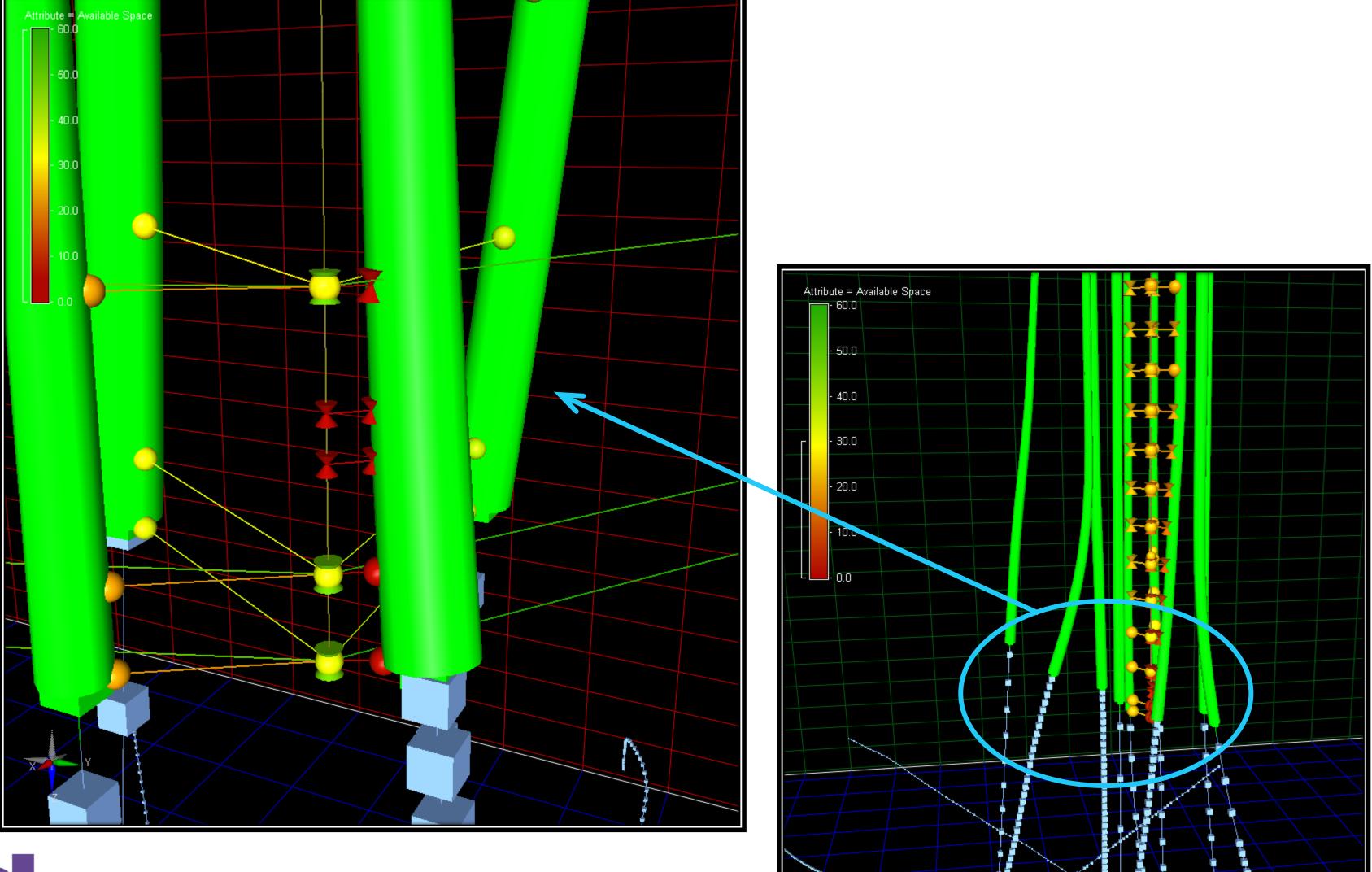








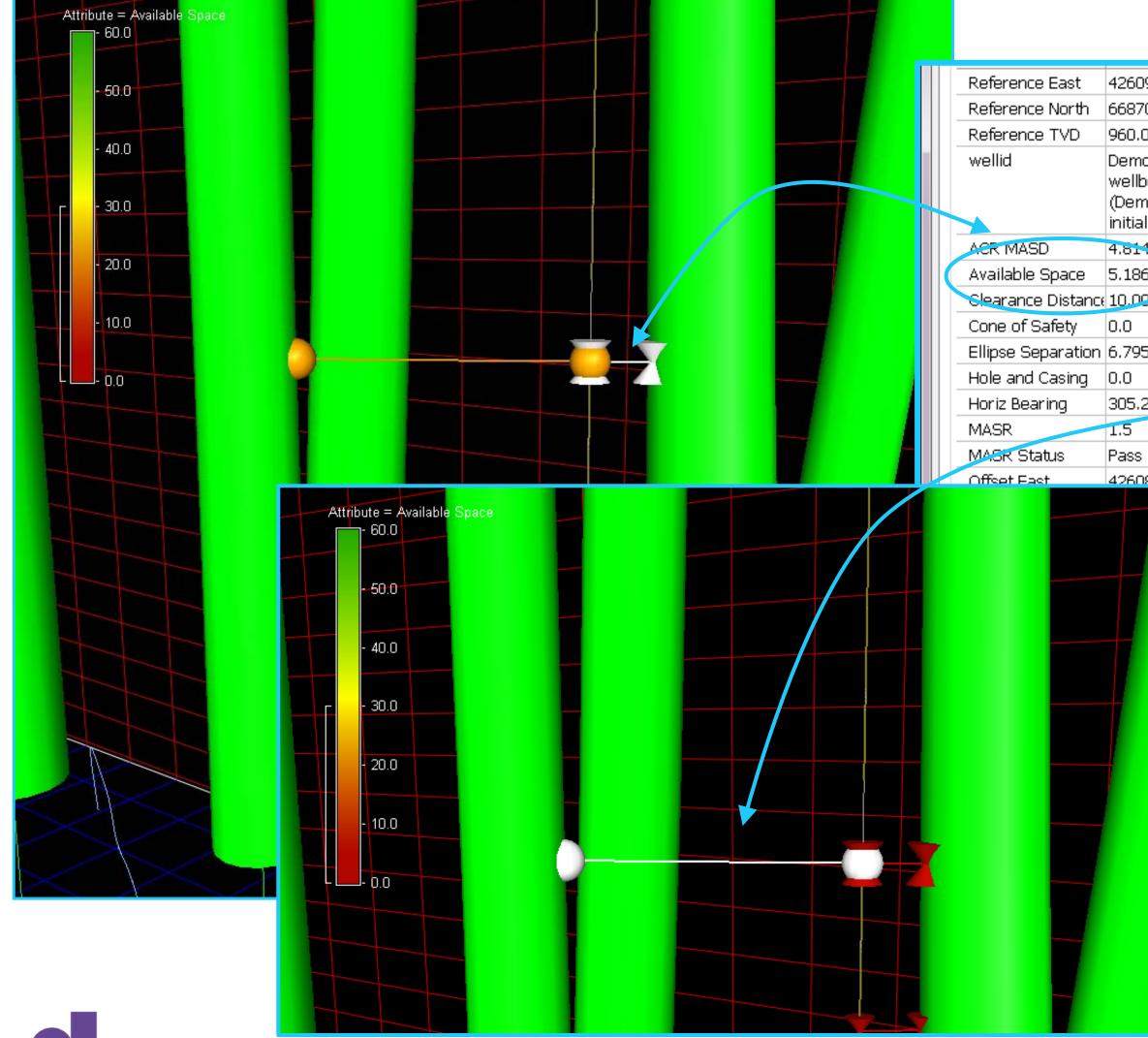
Altering Path Based on Available Space







Altering Path Based on Available Space



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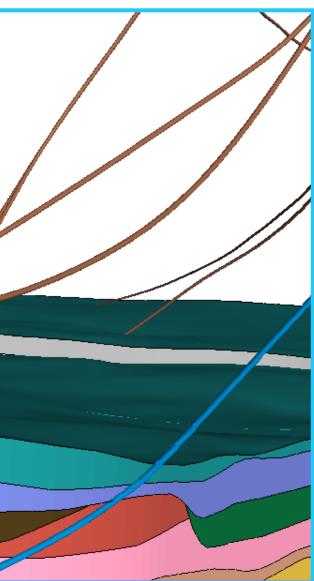
	File Query		X
	File: Demo_wellbore_CR_Re	ef.path	+
90.91	Query Info Edit defaults		
009.983)	Edit table 🛛 🖸 7,	/8	
C	Query Table		
iore	Attribute Value	Unit	
i 1000)	Reference East 426090.91	m	
15	Reference North 6687009.983	3 m	
58	Reference TVD 960.0	m dow	
5	wellid Demo wellbore (Demo - initial 1000)		
	ACR MASU 3.7413	m	
248	Available Space 22.0195	m	
	Clearance Distance 25.7694	m	
	Cone of Safety 0.0	m	
82 74	Ellipse Separation 23.2752	m	
	Hole and Casing 0.0	m	
	Horiz Bearing 143.06	0	
	MASR 1.5	fract	
	MASR Status Pass		Ξ
	Offset East 426106.39	m	_
	Offset MD 984.775	m	
	Offset North 6686989.394	4 m	
	Offset PCR 0.085433	m	
	Offset TVD 959.767	m dow	
	Offset Well 130/60A-D0	8	
	Probability of Collis NA		
	Reference MD 960.0	m	
	Reference PCR 2.4087	m	
	Separation Ratio 10.3318	fract	
	Use 1		
	azimuth (null)		
	dl_severity (null)		
	dumbbell_x 426104.14	m	
	dumbbell_y 6686992.385	5 m	
	dumbbell_z 959.801	m dow	
	inclination (null)		
	linecol 5		
	md 960.0	m	-
		m	Ŧ

Analyze.

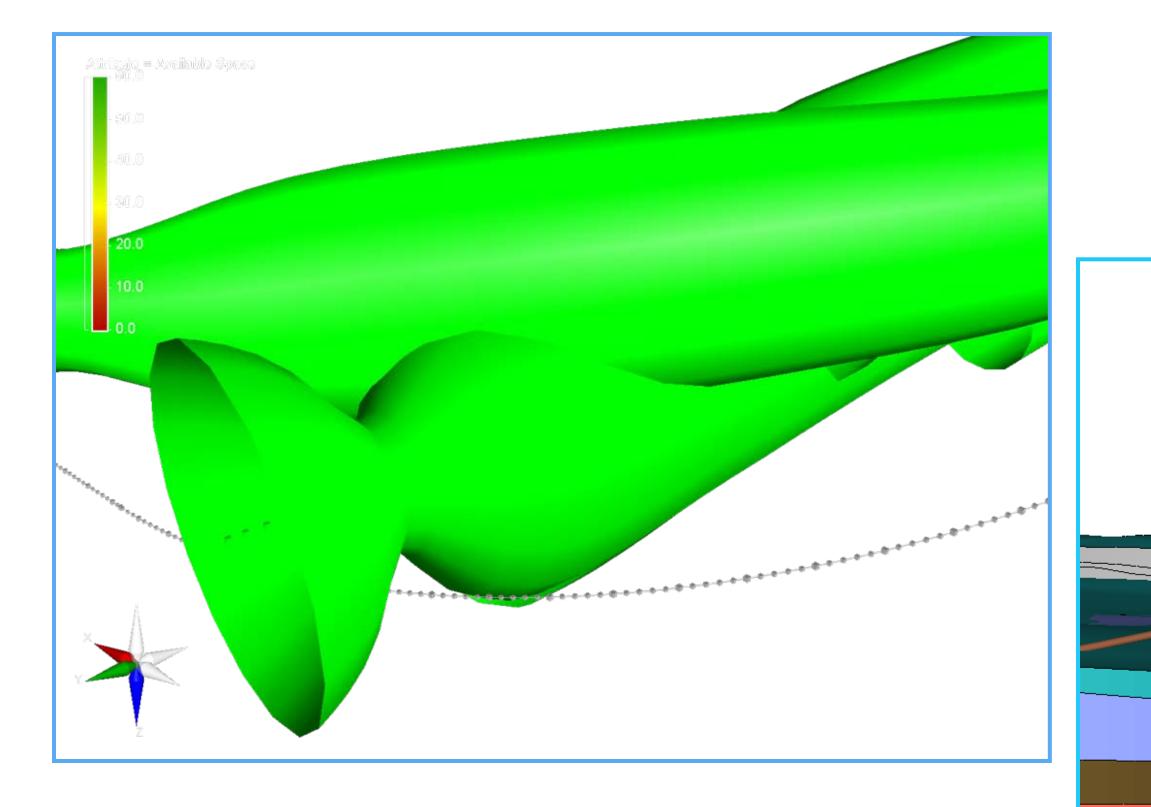
Report and 3D Viewing May Not Be Enough

Attribute = Zone							
.0.		ted in Closest A					
	~ ~ ~	-1 -1 -1 -1 -1	I	4	CD 6	-tion Dotto	
		C Clearance Dist				ation Ratio Min Ratio	4 <i>C</i> P
	C-C Ref MD [m]	C Clearance Dist Min C-C Clear Dist [m]	Diverging from MD	Ref MD of Min Ratio	CR Separ Min Ratio	ation Ratio Min Ratio Dvrg from [m]	ACR Status
	Ref MD	Min C-C Clear Dist	Diverging	Ref MD of	Min	Min Ratio Dvrg from	
	Ref MD [m]	Min C-C Clear Dist [m]	Diverging from MD [m]	Ref MD of Min Ratio [m]	Min Ratio	Min Ratio Dvrg from [m]	Status
	Ref MD [m] 2804.27	Min C-C Clear Dist [m] 56.89	Diverging from MD [m] 2804.27	Ref MD of Min Ratio [m] 2757.13	Min Ratio 1.59	Min Ratio Dvrg from [m] 2880.00	Status PASS
	Ref MD [m] 2804.27 979.21 979.21 750.00	Min C-C Clear Dist [m] 56.89 12.58 12.58 63.63	Diverging from MD [m] 2804.27 3060.00 2940.00 2370.00	Ref MD of Min Ratio [m] 2757.13 3220.06 2889.16 2440.21	Min Ratio 1.59 2.17 3.67 7.49	Min Ratio Dvrg from [m] 2880.00 3220.06 2889.16 2440.21	Status PASS PASS PASS
	Ref MD [m] 2804.27 979.21 979.21 750.00 951.65	Min C-C Clear Dist [m] 56.89 12.58 12.58 63.63 24.86	Diverging from MD [m] 2804.27 3060.00 2940.00 2370.00 951.65	Ref MD of Min Ratio [m] 2757.13 3220.06 2889.16 2440.21 1023.78	Min Ratio 1.59 2.17 3.67 7.49 9.42	Min Ratio Dvrg from [m] 2880.00 3220.06 2889.16 2440.21 3220.06	Status PASS PASS PASS PASS
	Ref MD [m] 2804.27 979.21 979.21 750.00 951.65 0.00	Min C-C Clear Dist [m] 56.89 12.58 12.58 63.63 63.63 24.86 23.88	Diverging from MD [m] 2804.27 3060.00 2940.00 2370.00 951.65 570.00	Ref MD of Min Ratio [m] 2757.13 3220.06 2889.16 2440.21 1023.78 857.38	Min Ratio 1.59 2.17 3.67 7.49 9.42 9.88	Min Ratio Dvrg from [m] 2880.00 3220.06 2889.16 2440.21 3220.06 3220.06	Status PASS PASS PASS PASS PASS
	Ref MD [m] 2804.27 979.21 979.21 750.00 951.65 0.00 851.57	Min C-C Clear Dist [m] 56.89 12.58 12.58 63.63 63.63 24.86 23.88 42.86	Diverging from MD [m] 2804.27 3060.00 2940.00 2370.00 951.65 570.00 851.57	Ref MD of Min Ratio [m] 2757.13 3220.06 2889.16 2440.21 1023.78 857.38 810.93	Min Ratio 1.59 2.17 3.67 7.49 9.42 9.88 14.30	Min Ratio Dvrg from [m] 2880.00 3220.06 2889.16 2440.21 3220.06 3220.06 3220.06	Status PASS PASS PASS PASS PASS
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	Ref MD [m] 2804.27 979.21 979.21 750.00 951.65 0.00 851.57 0.00 570.00	Min C-C Clear Dist [m] 56.89 12.58 12.58 63.63 63.63 24.86 23.88 42.86 53.85 53.44	Diverging from MD [m] 2804.27 3060.00 2940.00 2370.00 951.65 570.00 851.57 900.00 570.00	Ref MD of Min Ratio [m] 2757.13 3220.06 2889.16 2440.21 1023.78 857.38 810.93 1006.62 715.26	Min Ratio 1.59 2.17 3.67 7.49 9.42 9.88 14.30 15.99 17.18	Min Ratio Dvrg from [m] 2880.00 3220.06 2889.16 2440.21 3220.06 3220.06 3220.06 3220.06 810.00	Status PASS PASS PASS PASS PASS PASS PASS
	Ref MD [m] 2804.27 979.21 979.21 750.00 951.65 0.00 851.57 0.00	Min C-C Clear Dist [m] 56.89 12.58 12.58 63.63 63.63 24.86 23.88 42.86 53.85	Diverging from MD [m] 2804.27 3060.00 2940.00 2370.00 951.65 570.00 851.57 900.00	Ref MD of Min Ratio [m] 2757.13 3220.06 2889.16 2440.21 1023.78 857.38 810.93 1006.62	Min Ratio 1.59 2.17 3.67 7.49 9.42 9.88 14.30 15.99	Min Ratio Dvrg from [m] 2880.00 3220.06 2889.16 2440.21 3220.06 3220.06 3220.06 810.00 3220.06	Status PASS PASS PASS PASS PASS PASS PASS

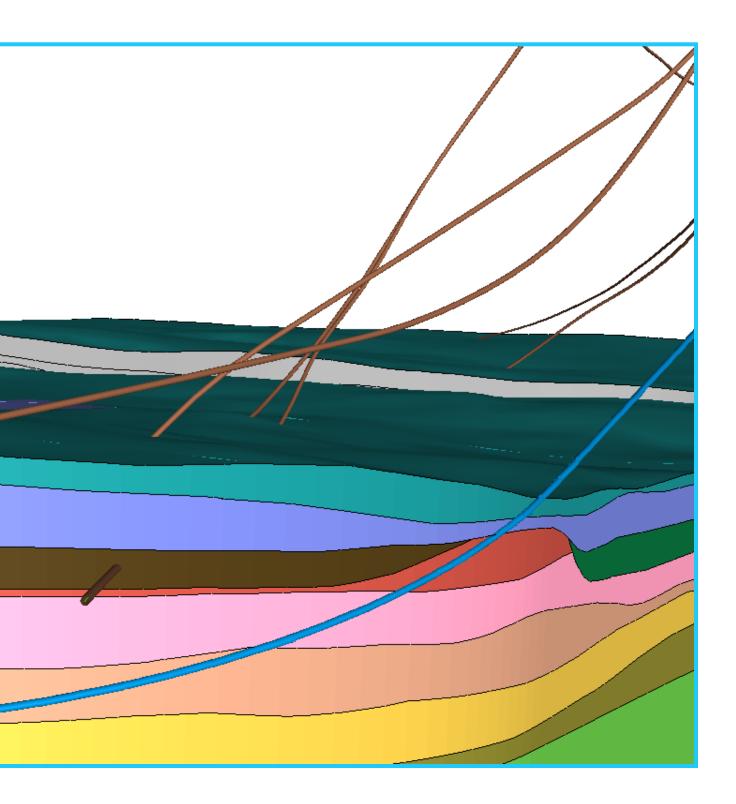




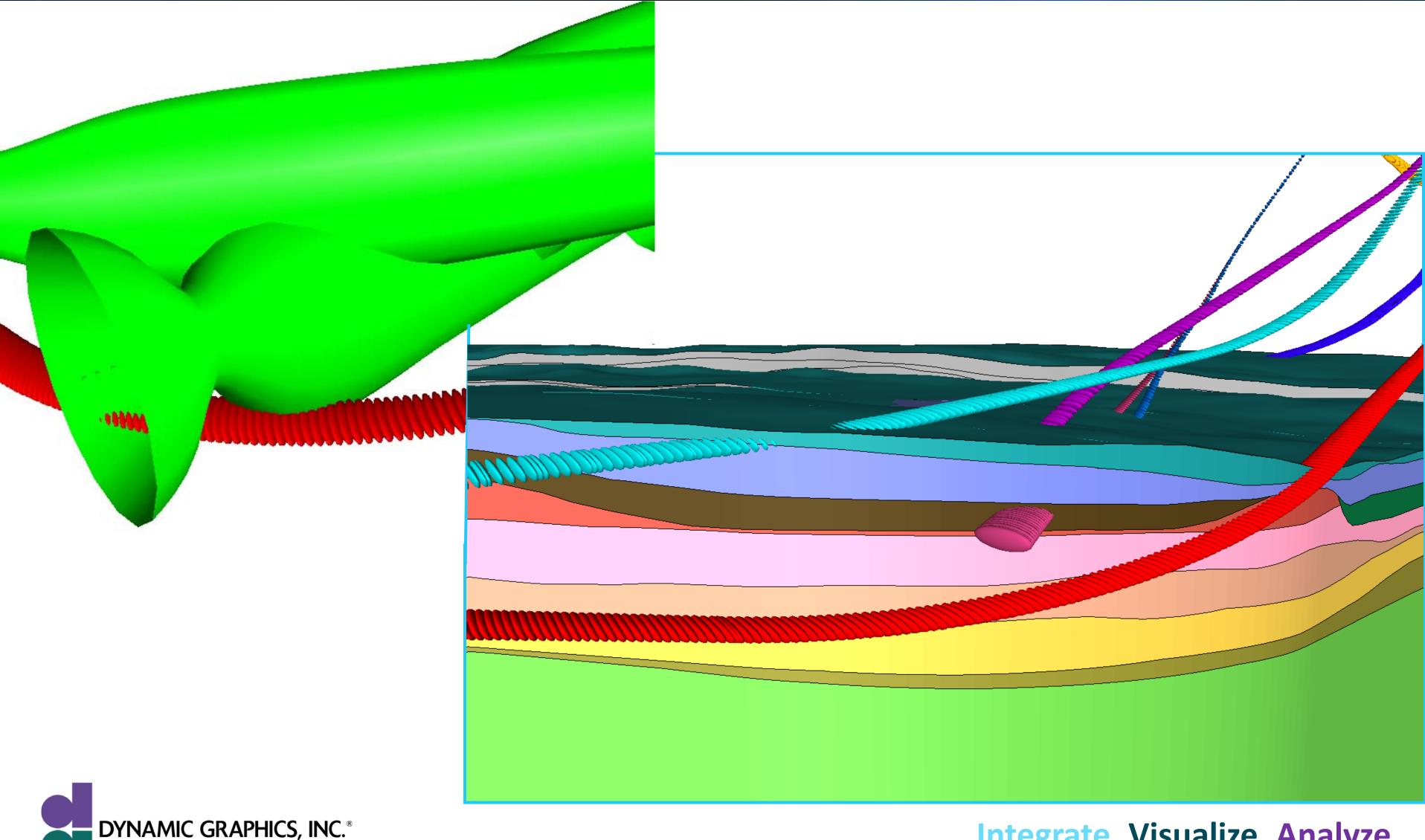
Viewing in 3D Shows How Relative Ellipsoid Angle Affects MASD – Pronounced Thinning



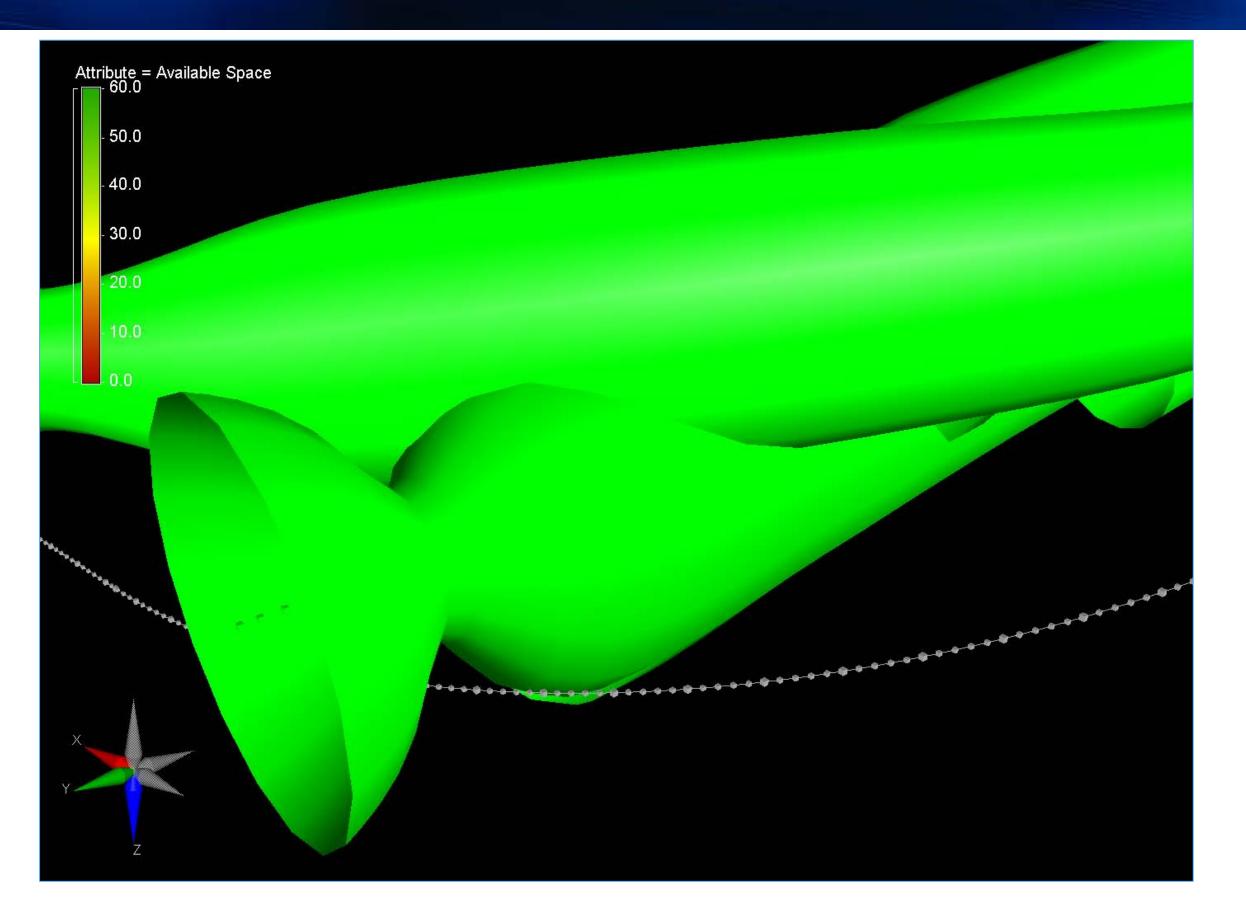




Viewing in 3D Shows How Relative Ellipsoid Angle Affects MASD – Pronounced Thinning



Adding Tubes with Radius = MASD / Available Space

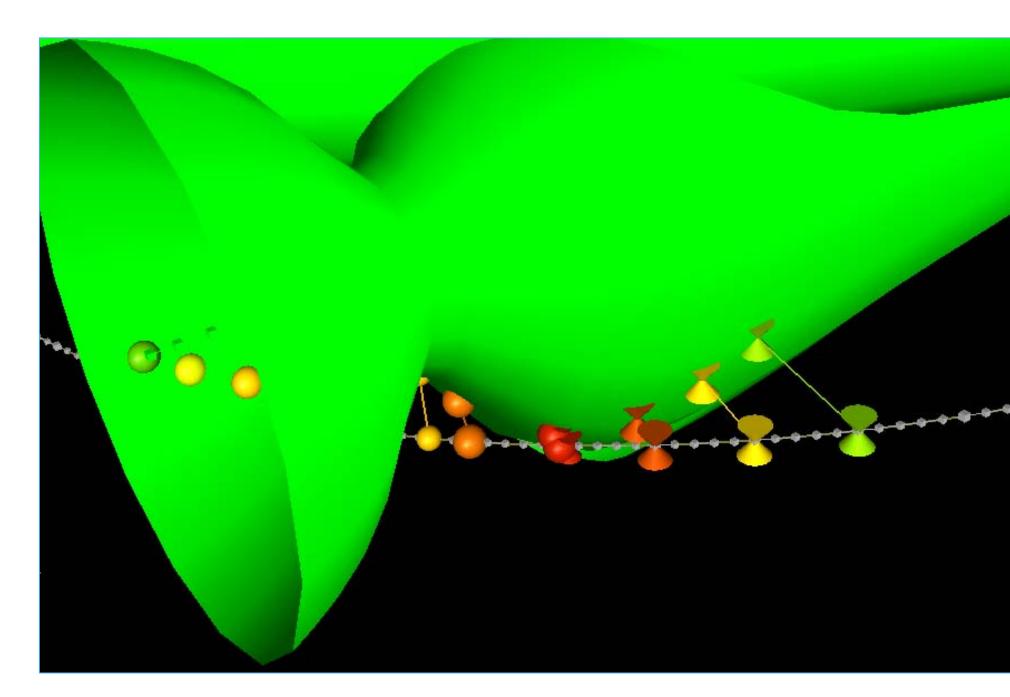




- Report shows we passed the ACR
- Green = Pass

Adding Tubes with Radius = MASD / Available Space

File Query			X
🕸 File: Demo_well	bore_CR_Ref.;	oath	- Þ
Query Info Edit c	lefaults		
Edit table	2 3/6		
Query Table			
Attribute	Value	Unit	
Reference East	426653.98	m	
Reference North	6687786.415	m	
Reference TVD	2201.38	m dow	Ξ
wellid	Demo wellbore (Demo - alternate kick off rev1 - TD azi 80,		
	inc 98)		
ACR MASD	64.9405	m	
Available Space	3.7162	m	
Clearance Distance	68.6683	m	

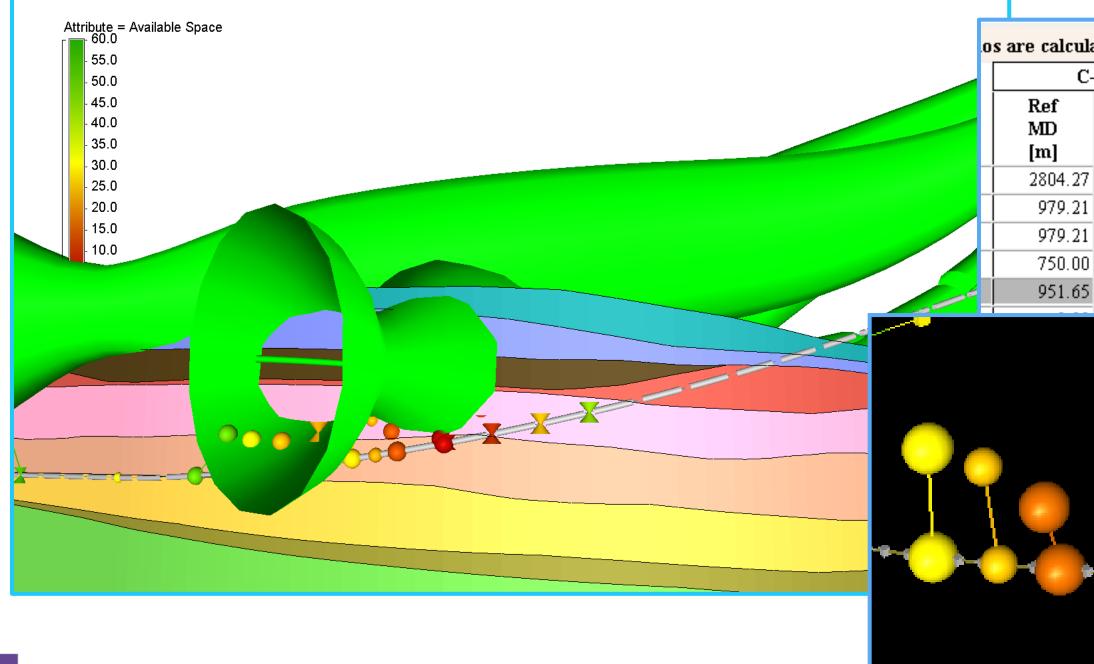


But Available Space shows a more informative story

...which we can then correct quickly

Conclusions

- We have the numbers, but what's full extent of their meaning?
- 2D tools are excellent at telling us something is wrong
- By finding ways to bring the 2D information into 3D, we can have a better understanding of the full context of the issues
- Plus we quickly evaluate a wider range of options, leading to better, safer wells





C-0	C Clearance Dist	tance	ACR Separation Ratio				
	Min C-C Clear Dist [m]	Diverging from MD [m]	Ref MD of Min Ratio [m]	Min Ratio	Min Ratio Dvrg from [m]	ACR Status	
7	56.89	2804.27	2757.13	1.59	2880.00	PASS	
1	12.58	3060.00	3220.06	2.17	3220.06	PASS	
1	12.58	2940.00	2889.16	3.67	2889.16	PASS	
0	63.63	2370.00	2440.21	7.49	2440.21	PASS	
5	24.86	951.65	1023.78	9.42	3220.06	PASS	
		ll	Î	I		PASS	
						PASS PASS PASS PASS	
	••	++++			***		

Acknowledgements

- Andy Sentance, Dynamic Graphics
- Gary Skinner, Gregory Forde, and Baker Hughes

And to the ISCWSA and the

audience, thank you....



